Original Article

Hypochlorous Acid for Community Level Wound Management: A New Horizon in Public Health

Suad Sulaiman[1], Elfadil Osman[1], Bakri Nour[2], Mohamed Saud[2], Hanan Ali[5] Alsharief Nour[2], Hassan ElShami[3], Eric Rasmussen[4], Jeffrey Williams[6]

[1]PhD, Professor, Sudanese National Academy of Sciences, Sudan, ORCID: 0000_0003_2327_9131: Elfadil Osman, BSc, Sudanese National Academy of Sciences, Sudan ORCID: 0000_0001_5981_4373, [2]PhD, Professor, University of El Gezira and State Ministry of Health, Sudan, ORCID: 0000_0002_2066_4176. Mohamed Saud, MD; University of El Gezira and State Ministry of Health, Sudan, Alsharief Nour, MBBS; University of El Gezira and State Ministry of Health, Sudan. [3]MBBS, Omdurman Islamic University, Sudan ORCID: 0000_0001_7239_9549, [4]MD, MDM, FACP, School of Public Health, University of Washington, USA ORCID: 0000_0001_7148_2180,[5] PhD, National Health Labs, Ministry of Health, Sudan,[6] Prof, PhD, BVSc, MRCVS: Meinhold Road, Langley, WA, USA

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Abstract

Background& Objectives: Hypochlorous acid (HOCl) is a safe antimicrobi aleffective for wound care in areas burdened by chronic infections such as mycetoma. Its broad antimicrobial activity, biofilm disruption, and exceptional tissue compatibility make it well-suited for the long-term management of complex wounds. In mycetoma-endemic regions, HOCl offers a practical assistant for infection control and improved wound healing, providing a low-cost option for strengthening community-level care.

Methods: This preliminary field-based humanitarian effectiveness, observational study evaluated the topical application of HOCl on seven patients with mycetoma lesions in Wad Shigidi Village, Sudan. The HOCl intervention was adjunctive and topical, not systemic. Weekly field visits were conducted, and lesion responses were documented using photographic and clinical criteria.

Results: Patients demonstrated marked reductions in lesion size, discharge, and pain. No adverse effects were reported.

Interpretation & Conclusions: HOCl shows promise as a safe, low-cost topical agent for mycetoma and other wound care at the community level in humanitarian settings. Further studies are warranted.

Keywords: COMMUNITY MANAGEMENT, HYPOCHLOROUSACID, MYCETOMA, SUDAN, WOUNDS,

Corresponding Author: Suad M. Sulaiman, PhD, Professor, Sudanese National Academy of Sciences, Sudan, Elfadil Osman,BSc, Sudanese National Academy of Sciences, Sudan.

E-mail: suadsulaiman@gmail.com

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Introduction

Mycetoma was first described in the mid-19th century in southern India[1]. The condition was later recognised in many areas of the tropical and subtropical world, with reports of cases from Chad, Ethiopia, India, Mauritania, Mexico, Senegal, Somalia, Sudan, Thailand, Venezuela, and Yemen. Although the causative organisms and their classifications have been characterised[2], the early clinical and pathological observations remain important today as laboratory diagnosis is still difficult and treatment options are limited [3].

Medical antimicrobial interventions often fail given the insusceptibility of the causal, slow-growing fungi and filamentous bacteria commonly associated with the condition, and the toxic side effects of long-term treatment with antifungal therapeutics. Clinical management is further complicated by patients' late presentation, at which point the disease is advanced enough in the disease process to allow these organisms and the granulomatous host responses to become well-entrenched in the nodular masses that characterise mycetomata[4].

The frequent occurrence of the disease in rural areas without ready access to primary healthcare facilities underlies all these complications in its management. The absence of any readily available countermeasures that could enable better patient home or even self-care has been identified as one of the major difficulties in reducing its impact in endemic areas[5], [6].

Hypochlorous acid (HOCl) solutions are proven to be powerfully antimicrobial, including having broad-spectrum antifungal efficacy [9]. When applied topically to a variety of infected lesions, there is compelling evidence that HOCl solutions also provide for enhanced healing, particularly important in the resolution of chronic wounds[7], [8]. Highly stabilised HOCl formulations provide a significant advantage in wound management because they remain chemically stable and do not degrade into harmful chlorine by-products. Many commercially available HOCl solutions lack adequate stabilisation, leading to the formation of hypochlorite and other chlorine species that are unsafe for human tissue and can impair healing. In contrast, properly stabilised HOCl maintains purity, avoids insoluble residues, and preserves extracellular matrix integrity while delivering potent antimicrobial and anti-inflammatory activity. Importantly, HOCl exhibits rapid, non-selective oxidative killing of microorganisms, giving it efficacy against drug-resistant bacteria and other pathogens without contributing to antimicrobial resistance. This residue-free, non-cytotoxic profile allows epithelial and granulation tissues to progress without chemical interference, making stabilised HOCl particularly suitable for chronic and complex wounds requiring frequent cleansing and long-term care [9].

Recent literature provides strong evidence supporting the healing potency of HOCl across chronic, infected, and complex wounds.A 2025 WHO Expert Committee review on the Essential Medicines List (EML) highlights HOCl as a safe, potent wound-cleansing agent with no toxicity to mammalian cells, noting strong evidence for improved healing in diabetic foot wounds and moderate evidence for septic surgical wounds. The same review emphasises that HOCl accelerates tissue restoration and supports the time wound-care framework through antimicrobial action, biofilm disruption, and excellent tissue compatibility[10]. Clinical evidence from an uncontrolled study in India demonstrates HOCl's practical healing impact: all patients with chronic open wounds achieved complete healing within 8–15 weeks using stabilised HOCl for routine wound cleansing[11].

Here, we report observations following topical application of stabilised HOCl to mycetoma lesions in a series of 7 patients in the Gezira area of Sudan. In this study, HOCl was applied only as a topical adjunct to local wound care; no systemic administration was used or intended. Our observations and the patients suggest that there may be beneficial effects worthy of expanded study, given the urgency of present-day needs for improved care options for similar conditions.

Material & Methods

Date of study: This study was conducted from January to early April, immediately preceding the outbreak of conflict on 14 April 2023. During this period, Sudan faced a weakened economy, ongoing political tension following the 2021 military takeover,

frequent public demonstrations, and widespread shortages of electricity, fuel, health services, and essential goods. Despite these challenges, the population did not anticipate a full-scale war, and daily life in many areas remained relatively calm.

Study location: All patients were residents in Wad Shigidi Village on the eastern bank of the Blue Nile, a population of 12,000. This rural site was selected because of the frequency of cases reported to the Mycetoma Centre, Wad Madani[12]. Most people in this village are engaged in farming and livestock management (Personal communication). The ongoing violence caused by the civil war complicated the serial evaluation of patient responses by caregivers from the University of El Gezira and the provincial Health Ministry.

Aim of the study: The research team, composed of staff from the University of El Gezira and the State Ministry of Health, held a meeting with the village leader, school-teachers, and community members to explain the study and the use of HOCl disinfectant for wounds in patients. The possible benefits of the product were described, emphasising that it had not previously been used in mycetoma patients in Sudan or elsewhere. The HOCl solution was to be applied as a potentially broad-acting disinfectant in One Health-based initiatives targeting wound infection management and antibiotic resistance mitigation in the local environment.

Patient selection: Candidates were identified based on their clinical presentation, history, and the limited availability of alternative therapeutic options under the prevailing conflict conditions. None of the patients reported current use of medication for mycetoma. Identification of the causative microbial species was not possible due to the absence of laboratory facilities in or near the village. Patients were therefore monitored by the caregivers weekly to document any clinical improvement associated with repeated topical application of HOCl. In six patients, the infection had persisted for several years, with individuals having previously undergone intermittent courses of antifungal or antibacterial therapy without satisfactory response, and some having been subjected to attempted surgical excision.

Informed Consent: All patients were informed about the study procedures by their caregivers prior to application of the HOCl solution. Written informed consent was obtained from each participant, and the signed consent forms were retained in the patients' medical files in accordance with international ethical guidelines and the requirements for inclusion of human participants in public health research.The first patient, an 11-year-old girl, was brought in by her elder brother, and he signed her form.

HOCl disinfectant solution: Stable pure HOCl preparations made by Briotech Inc., equivalent to those available commercially in the US from Amazon,were donated for this study. Use of the product for the study was approved by the Sudanese National Medicines & Poisons Board in Khartoum. The proposed study received approval from the Ethical Committee ofthe Sudanese Federal Ministry of Health(Proposal No. 8-3-21, April 2021) and the State Ministry of Health (Ethical permit No. 44 T, January 2024) before the HOCl was used.

Topical use patterns and observations: Patients were provided with sufficient HOCl solution to allow for week-long daily applications to the lesions, either as a spray or directly poured onto the open wounds. Spray bottles containing 100 ml of HOCl (100 ppm concentration) were given to each patient. Patients were instructed to apply the disinfectant to their wounds two to three times daily, allow several minutes of contact, apply HOCl to the wound dressing, and then dress the wound using sterile gauze and bandages provided. HOCl bottles were refilled by caregivers as needed.

Examinations and observations by the caregivers were made at intervals when possible, and extensively recorded photographically to capture changes, along with patient comments on any perceived benefits, such as better drainage, reductions in lesion size, granular discharge, malodour, pain, and each patient's willingness to continue HOCl applications.

Results

Patient # 1.

An 11-year-old female presented with an early-stage painless right foot lesion (~2 x 2 cm) of mycetoma accompanied by foul serosanguinous purulent exudation (Figure 1a). There was discharge

of granular material via at least three sinus tracts. Patient's male sibling had a longer- standing mycetoma infection, indicative of the presence of causal organisms in the family environment. Patient was compliant with 3x (TID) daily topical application of the HOCl as the sole therapeutic intervention over the study period. Upon examination weekly, over one month, the lesion showed progressive signs of resolution, including cessation of fluid and granular discharge, drying and shrinkage of the area affected, and ultimately closure of the skin breach and encouraging signs of skin healing. (Figure 1b).

Figure 1: An 11-year-old girl with an early mycetoma ulcer.
1a: 1st presentation 1b: 4 weeks post-HOCl use

Patient #2:

A 25-year-old male, a goat herder, presented with a case of long-standing pedal mycetoma, with numerous sinuses discharging white granules. His history included three surgical interventions over seven years with unsatisfactory outcomes overall. The patient was eager to participate in the evaluation and was compliant with 3x (TID) daily topical HOCl. Two weeks later, he reported a noticeable reduction in swelling and pain, increased mobility, the onset of healing of lesions, closure of some sinuses, and reduced volume of discharged granular material. This led to a willing continuation of the HOCl applications over eight weeks. Serial observations by care providers over that time confirmed beneficial changes. (Figure 2:)

Figure 2: A case of a long-standing pedal mycetoma
2a: At presentation 2b: 8 weeks after using HOCl, less swelling, drylesions with granulation tissueand eschar

Patient#3:

A 20-year-old male who had had the infection for seven years before the study. He presented severe chronic lesions affecting the right thumb, which had undergone several unsuccessful surgeryattempts in previous years. The patient observed a decrease in lesion size, odour, and pain over the course of 8 weeks.

Patient #4

A 35-year-old female housewife with a single discharging foot lesion that had been treated both surgically and with antifungal medication for several years. Over the course of HOCl treatment, with intermittent compliance, the sinus discharge ceased, and the lesion closed.

Patient #5

A 35-year-old female housewife with a history of pedal mycetoma of more than 20 years duration. Her history included three surgical procedures and serial medication with antifungal agents. She was fully compliant with the HOCl protocol, reporting remarkable improvements in the size of the lesions over the course of 8 weeks, reduced discharge, decreased pain, and recovered mobility of her toes.

Patient #6

A 35-year-old father and animal herder with extensive gluteal mycetoma initially presented eight years before the study. He underwent multiple surgical procedures. He was fully compliant, and changes were observed over the course of 8 weeks, indicating a favourable response to HOCl with reduced lesion size as well as drying and cessation of exudation in some of the multiple lesions covering the gluteal region and lower back (Figure 3a, 3b). This patient was seen recently by one of our local team (Prof. Nour), two years after being treated with HOCl (Fig. 3c).

Figure 3: A patient with extensive gluteal mycetoma
3a: before HOCl 3b: 8 weeks 3c: 2 years after using HOCl for 8 weeks

Patient #7.

A 45-year-old housewife with mycetoma of the knee, with multiple open discharging sinuses and two subcutaneous lesions above the knee. Patient confirmed having the lesions for three years, and unsuccessfully attempted antifungal treatment several times, and underwent one surgical procedure. Over the course of serial but intermittent use of HOCl, lesions were observed to have dried, and discharges were reduced.

Limitations of the Study

This study involved a small number of village-based patients to obtain preliminary observations on the effect of hypochlorous acid (HOCl) on mycetoma ulcers. Because HOCl is a broad-spectrum, fast-acting disinfectant, we proceeded without identifying the specific causative species, as such identification is normally required to guide antibacterial or antifungal therapy, which was not attempted in this study.

The wide variability of mycetoma lesions made matched control groups impractical; therefore, each patient served as his own control through pre- and post-treatment comparison. Plans to expand the study and conduct closer monitoring and compliance at the Madani Mycetoma Centre were interrupted by the conflict that began on 15 April 2023, which also prevented systematic follow-up of the study patients.

Long-term follow-up was limited, and only one patient (Patient #6) could be traced two years after treatment because of displacement and regional instability.

Despite these limitations, our findings suggest that HOCl may support wound improvement in mycetoma patients and merit further controlled evaluation in hospital settings.

Table 1: Summary of patients' presentations and findings after applying HOCl during the study

Pt # Age (yrs)	Sex Occupation	Site of wound	Duration of infection	Ulcers size	No. of sinuses	Colour Ofgrains	Observed Improvement
# 1 / 11	Female / Student	Top Rt foot	2 months No treatment	~2 x 2 cm	3 with discharge	Black	Ulcer healed on 4thwk of using HOCl
# 2 / 25	Male / Goat herder	Top of Rt foot	7 years three surgeries	Dorsal aspect of the foot	Numerous with discharge	White	Dry lesions, less swelling & pain, no discharge, granulation of wounds
# 3 / 25	Male / Shop-keeper	Rt hand & severe lesions on the thumb	7 years, Several surgeries	Severe lesions & thumb contraction	Several on both sides of the hand	Black	Decrease in lesions' size, odour & pain
# 4 / 35	Female/ House-wife	Dorsum of the right foot	>15 Yrs Several surgeries & medication	Single lesion with discharge	Single discharging sinus	Black	Ceased discharge & lesion closed
# 5 / 35	Female/ House-wife	Dorsum of the left foot	>18 yrs, several surgeries	Single extended lesion with discharge	Many sinuses with ulceration	Black	Sinuses closed, reduced discharge. Start of healing
# 6 / 35	Male/ Animal herder	Extensive gluteal ulcers	>8 yrs Multiple surgeries	Several extended lesions	Many discharging	Black	Reduced lesion size with drying, less exudate in many lesions. Most lesions dried, forming dark, dry crust 2 yrs after using HOCL

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#7 / 45	Female/ House-wife	Upper side of right knee	>3 yr unsuccessful antifungal drugs	Many ulcers & 2 subcutaneous lesions above the knee	Several discharging sinuses	Black	Lesions dried and discharge reduced

Discussion

Although the patients involved in this preliminary evaluation adhered to the recommended protocol for HOCl application to varying degrees, there was no indication that topical use resulted in adverse effects, which would have caused rejection or failure to comply. On the contrary, observable benefits led to enthusiasm for the continuation of treatment in the seven patients. It does not appear, therefore, that self-administration of topical HOCl by patients suffering from mycetoma would result in anything other than possible benefits. These findings encourage the pursuit of further, longer-term usage.

The resolution of an early lesion observed in patient #1 encourages the inference that the simple intervention method employed could help provide a measure of support for home care by patients themselves. Such treatment might complement therapeutic regimens conventionally employed in case management. The changes recorded in the other patients with more established and long-standing disease lesions, including declines in discharge volumes and frequency, reduction of overall lesion swelling, reduction in malodour release, pain, and reported improvements from patients and caregivers, are also supportive of the potential value of exposure of mycetoma lesions to HOCl in this way. The absence of any available means whereby patients could self-medicate has long been recognized as a serious shortcoming in the armamentarium available to health care providers confronting the chronicity of this condition in rural environments[4,6]. The simplicity of the measure used here favours adoption and compliance by those afflicted. Even if the overall effects are no more than complementary to the typical processes involved in case management, there are likely benefits that will accrue from the ongoing broad-spectrum antimicrobial efficacy of the HOCl solution (as seen in patient no. 6, 2 years post-use). With the advent of pure, stable formulations of HOCl using contemporary manufacturing methods, there is good reason to think that it will retain high levels of effectiveness even in the demanding circumstances posed by tropical environments typified by the conditions in Sudan[13].

Conditions resembling mycetoma in domestic livestock—caused by microorganisms essentially identical to those responsible for human disease—are widespread in the same rural environments where human infections are common[14]. Whether or not these instances, particularly but not exclusively in ruminants, contribute to the propagation of causal opportunistic pathogens responsible for human disease may be worthy of further investigation. However, the occurrence of pathological changes in domestic animals that mimic those seen in human patients provides an opportunity for evaluation of topical HOCl in ways that could be helpful to our understanding of its full potential as an intervention. Protocols of regular infusion of aqueous HOCl into sinuses, draining such lesions, might well enable conclusions to be drawn about the utility of that kind of measure in human cases. Topical use of stable gels of HOCl, especially when used in combination with liquid HOCl, may provide for an effective delivery system, especially since HOCl solutions have an immediate cleansing, debridement-like effect on dead tissue accumulations in chronic wounds[15]. Emerging evidence for significantly higher levels of antimicrobial efficacy ofhypobromous acid solutions versus HOCl could also be put to the test in patterns applied to domestic animal lesions[16].

Overall, however preliminary these observations may be, they open possibilities for improvement of home care that may prove valuable and appear worthy of further evaluation. This is particularly fitting given the seriousness of occurrences of mycetoma in populations that often have limited access to the care that such cases merit and require. Management of early infections at the community level may prove useful in confronting the increasing prevalence of mycetoma in younger age groups[17].

A critical challenge remains the sustainable supply of HOCl. Given the considerable number of patients requiring ongoing care, the reliance on imported supplies is neither cost-effective nor logistically feasible. There is an urgent need to establish local production capacity to ensure consistent availability. Efforts are underway to develop compact, low-cost devices capable of generating stable HOCl on-site. These efforts could transform wound care delivery in low-resource settings, enabling early and community-led treatment models.

Due to the conflict in Sudan since April 2023 and the wide displacement of people to different parts of the country, it was not possible to trace the patients included in the study, except for Patient 6.

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Competing Interests: The authors declare that they have no competing interests related to this study. No financial, personal, or professional affiliations influenced the design, execution, or reporting of the research.

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Original Article

Oral Health Alterations Associated With Menopause: A Comparative Analysis of Pre- and Post-Menopausal Women

Sujal R Chorge[1], Kamala KA[2], S. Sankethguddad[3], Ashwinirani SR[4], Madhura Mahajan[5]

[1]Final year BDS. School of Dental Sciences, KVVDU, Karad, District- Satara, Maharashtra, India. [2]M.D.S, Ph.D., Associate Professor, Department of Oral Medicine and Radiology. School of Dental Sciences, KVVDU, Karad, District- Satara, Maharashtra, India. [3]Associate Professor, Department of Periodontology, HKDET'S Dental College, Hospital and Reaserch Institute, Humnadad, Karnataka, India. [4]Associate Professor, Department of Oral Medicine and Radiology. School of Dental Sciences, KVVDU, Karad, , District- Satara, Maharashtra, India. [5]Senior Lecturer, Department of Oral Medicine and Radiology. School of Dental Sciences, KVVDU, Karad, District- Satara, Maharashtra, India.

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Abstract

Background: Menopause is a natural physiological transition characterized by a decline in estrogen and progesterone levels, which can influence both systemic and oral health. The presence of estrogen receptors in oral tissues renders them susceptible to hormonal fluctuations, leading to various oral complaints. However, these manifestations are often under-recognized in clinical practice. The present study aimed to evaluate and compare oral health alterations, including oral and psychological symptoms, dental status, periodontal health, and clinical findings, between premenopausal and postmenopausal women.

Materials and Methods: A cross-sectional comparative study was conducted among 200 women, comprising 100 premenopausal and 100 postmenopausal participants. Data were collected using a structured questionnaire covering demographic details, oral and psychological symptoms, and oral hygiene practices. Clinical examination assessed dental status, periodontal condition, and oral mucosal changes. Statistical analysis was performed using descriptive statistics and Chi-square test, with $p < 0.05$ considered statistically significant.

Results: Postmenopausal women demonstrated a significantly higher prevalence of oral symptoms such as xerostomia (48% vs. 18%), burning mouth sensation (20% vs. 2%), altered taste (45% vs. 19%), halitosis (38% vs. 12%), orofacial pain (43% vs. 6%), and dysphagia (40% vs. 5%) ($p < 0.05$). Psychological symptoms including depression, anxiety, sleep disturbances, and memory impairment were also more frequent. Furthermore, postmenopausal women exhibited reduced dentition, increased prosthetic needs, poorer oral hygiene practices, and higher occurrence of mucosal conditions.

Corresponding Author: K. A. Kamala, Associate Professor, Department of Oral Medicine And Radiology, School of Dental Sciences, KVVDU, Karad, District- Satara, Maharashtra, India.

E-mail: kamsweetsmile@gmail.com

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